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# Predictions Markets for Programmatic Decision Support

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## What are some challenges facing DOE/NNSA?

### Prioritization of:

- Risk mitigation activities and spending
- Capital infrastructure investments
- Technology investment decisions
- Design options & producibility



**Subject Matter Inputs:** Prediction markets help make better decisions by quickly and accurately gathering SME inputs





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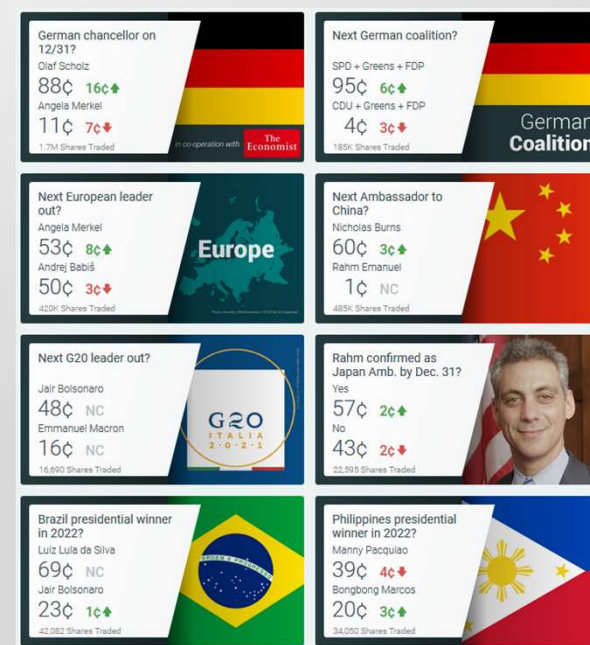
## What is a prediction market?

**Background:** Prediction markets allow participants to buy shares predicated on an event outcome, sometimes with real money. Share prices are an indicator of event likelihood, based on the collective assessment of the market.

- The ultimate objective of a prediction market is to aggregate information

Research suggests that prediction markets can be (but are not always) more accurate than individual SMEs or organizations in forecasting outcomes.

- Prediction market successes: 1988-2000 elections, 2020 election
- Prediction market failures: WMD in Iraq, John Roberts nomination, 2016 election



<https://www.predictit.org/>





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## Why predictions markets?



**CYBERSECURITY  
& INFRASTRUCTURE  
SECURITY AGENCY**



**Research Question:** National Risk Management Center (NRMC) relies heavily on subject matter expert (SME) input for critical infrastructure (CI) risk assessment, including estimates of event likelihood and consequence, often through informal interactions. Can prediction markets be used to more systematically gather this data?

- **Cybersecurity and Infrastructure Security Agency's (CISA)** works to ensure the security and resiliency of our critical infrastructure (an operational component of DHS)
- **National Risk Management Center (NRMC)** is housed within CISA to help fulfill the Agency's risk advisor role by leveraging sector and stakeholder expertise to identify the most significant risks to the nation, and to coordinate risk reduction activities to ensure critical infrastructure is secure and resilient both now and into the future



<https://www.cisa.gov/national-risk-management>



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## SME elicitation informs decision making

### Example: Programmatic decisions

- What if you could easily poll SMEs across the NNSA enterprise to gather additional information on areas of programmatic concern?
  - i.e. PRT/MRP Leads, technical leads, prior programs, other FPMs, customers

Option 1

Option 1a

Option 2

Option 3

### Questions of interest:

- Will a 1 month delay in flight test X lead to a 6 month delay to FPU?
- Will funding levels below WDCR requirements for 2 years lead to a 6+ month delay to FPU?
- Will a two week delay in delivery of test asset B to DoD lead to a missed flight test?
- Will redesigning component X remove the component from the critical path?
- Will removing/reducing requirement Y reduce program costs more than \$300M?
- Will issue X be resolved by increasing funding to hire 3 additional staff?







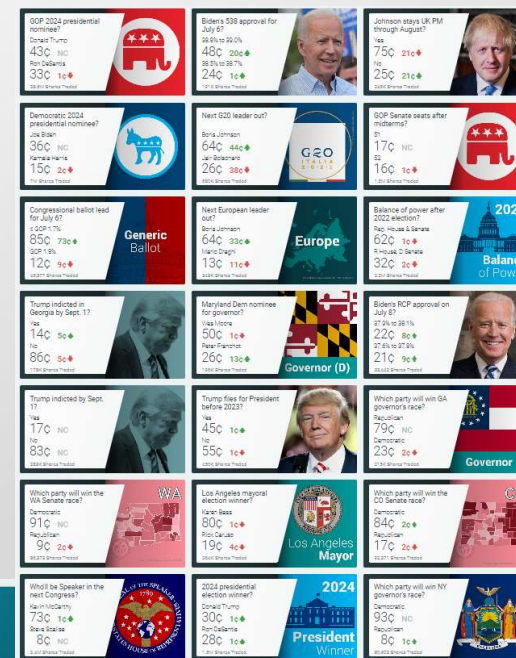
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## Prediction market examples

- Iowa Electronic Markets (IEM)
  - Political predictions
- Cultivate labs
  - The UK Government uses Cultivate Labs to crowdsource forecasts about influential geopolitical events to inform policy making
- Predict it
  - Political predictions



## How It Works



### Browse Markets

Check out the range of available markets on which you can try and predict the outcome.



### Make A Prediction

Think everyone's got it wrong? Put your money where your mouth is and buy shares for or against an event taking place.



### Trade Your Shares

Buy your shares low and sell them high once the crowd figures out you were right.

<https://www.predictit.org/>



## Basic prediction market design

- A time-bounded event or scenario of interest is identified.
- “Stocks” are generated in the form of Boolean predictive statements regarding potential outcomes (i.e. Event X will or will not happen). Stocks will pay \$1 if the event pans out as predicted.
- The market is opened to participants who begin with some amount of notional or real currency. Participants use their credits to purchase stocks and/or their inverse.
  - The value of a stock (between 0 and \$1) may be perceived as the likelihood the event does or does not happen, based on the collective judgement of the participant pool.
- When events terminate and/or the prediction market closes, stocks pay out to those who bet on the correct outcome.



## Necessary components for market to work

### Incentive compatibility

- How do you incentivize participation?

### Liquidity

- Traders need to be able to buy and sell their stocks

### Rationality

- We have to assume individuals are rational







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## Trading Strategies observed



Players can employ a range of trading strategies to explore the best possible odds:

- 1. Informed Trading** - Leveraging publicly available information and/or subject matter expertise to make bets.
  - 2. Capitalizing on Bad Traders** - Watching the market rankings and other player's performance to capitalize on their choices.
  - 3. Projected Odds** - i.e., market bet
  - 4. Quick Hedge** – how does it work?
    - User determined percentage for/against a certain stock and quantity of stocks
    - Owned stocks are sold at an advantageous price if they do not align with choice
    - For all remaining stocks not sold, trigger buy at an advantageous price
    - For all stocks that could not be purchased, market generates new stocks and lists for sale
- 1. Long-view Bet**
    - Set a general estimation in advance
    - Become more active as the stock nears closing
    - Requires high certainty and monitoring of real-world
  - 2. Advantageous**
    - Buy stocks listed at prices you think are lower than the chance it comes true.
    - Buy market pairs and list both sides for a total of more than \$1.
  - 3. Risk Averse**
    - Place buy orders for prices at or under your perception of their value.
    - Buy market pairs and immediately fulfill overpriced buy orders.
  - 4. Risk Neutral**
    - Buy market pairs and list the side you don't think will happen for the value you believe it may not happen.

This is one of the reasons why you need a large and diverse pool of participants





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## Predictions market recap

- Enables gathering of the wisdom of the crowd
- Easy and fun way to gather subject matter expert inputs
- Has proved to be competitive with individual SME elicitation and a valuable additional source of information





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# Questions?

Thank you!